

This Appendix was prepared from issue 41 of Drawing ST-52005-02

METHOD OF OPERATION

Line Circuit - District Selector Circuit - Line Finder Circuit - Arranged for Individual Message Register or Flat Rate Service - 400 Point Lockout Type Line Finder - Panel System

Change: Paragraph 20 and 21 To Read:-

20. LINE FINDER TIME ALARM WITHOUT TRIP CIRCUIT RELEASE (P" WIRING)

20.1 ALARM SIGNAL

If a line finder does not find the subscriber's line within 35 seconds after the receiver at the calling station is removed from the switchhook, an alarm is given in the following manner: The (BA) relay operated connects battery to winding of the (frame) relay (B), brush and terminal 1 of the START arc of the time alarm selector, break contact of the frame relay (A), to the interrupter contact. When the interrupter contact closes, the (B) relay operates. The (A) relay does not operate, however, on account of its winding being short circuited by ground on the interrupter. When the interrupter contact opens, the short circuit is removed from the winding of the (A) relay, which now operates in series with the winding and make contact of the (B) relay, to ground on the armature of the (B) relay, thus holding both relays operated. The next operation of the interrupter operates the (TA) magnet, over a circuit from ground on the make contact of the interrupter, make contact of the (A) relay, terminal 1 and brush of the STEP arc of the selector, to battery through the winding of the (TA) magnet. When the interrupter contact opens, the (TA) magnet releases and steps its brushes one step on its back stroke. The selector brushes advance one step for each make and break of the interrupter contact, which is of an interval of 7 seconds, until the fifth terminal of the selector is reached when the circuit through the interrupter is opened. When the fifth terminal of the selector is reached, the (BA) lamp in the trip circuit lights from battery on the armature of the (A) (frame) relay, terminal 5 and brush of the LAMP arc of the selector, through the make contact of the (BA) relay, (BA) lamp to ground through the winding of the (B) (aisle) relay in the time alarm circuit, which operates. The (B) relay operated, operates the (A) (aisle) relay. The (A) relay operated, lights the aisle pilot and main or monitoring board lamps through their respective auxiliary alarm circuits. When the source of trouble is removed and the (BA)

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Appendix #5
March 23, 1933

relay in the trip circuit has released, the circuits over the make contacts of the (BA) relay are opened, in turn releasing both the frame and aisle (A) and (B) relays, extinguishing the aisle and main or monitoring board lamps and silencing the alarm. The release of the (B) (frame) relay also closes a circuit from ground on its armature, through terminal 5 and the bridging brush of the RETURN arc of the selector to battery through the break contact and winding of the (TA) magnet, which operates and steps the selector brushes to terminal 6, in which position it awaits the next closure of contacts of the (BA) relay.

20.2 RESTORING TO NORMAL

Should the circuit over make contact of the (BA) relay be opened before the fifth terminal is reached by the selector, the (A) and (B) frame relays release. The (B) relay released, causes the selector to advance to the next normal position, awaiting closure of make contact of the (BA) relay, as previously described. The operation of the (TA) key steps the selector brushes to the next normal position by way of the STEP bridging brush and 5, 10, 15 or 20 terminal, as the case may be. If the selector has been at normal position 6, 11 or 16, when the (BA) relay operated, the operation would have been the same as described for position 1.

21. LINE FINDER TIME ALARM WITH TRIP CIRCUIT RELEASE ("U" WIRING)

21.1 The circuit description for this feature will be found in BT-226379 which is the method of operation for ES-226379.

ENG. ELF

CHK'D ELF

APP'D A. PENROD
S.C.E.

MARCH 23, 1933.
ED.

This Appendix was Prepared from Issue 35 of Drawing ST-52005-02.

METHOD OF OPERATION

Trip Circuit - Start Circuit - Line Finder Circuit and District Selector
Circuit - Arranged for Individual Message Register or Flat Rate Service -
400 Point Lockout Type Line Finder - Panel System

This appendix is issued to add paragraphs 47 and 48 which read as follows:

47. SUB-GROUP "A" LINE FINDERS ONLY EQUIPPED

When only sub-group "A" line finders are equipped, "C" wiring is omitted and "D" wiring furnished, and the operation of relay (SA) when a call comes in with all "A" line finders busy and relay (CA) operated, operates the message register. Also relay (STB) is prevented from operating under this condition by the omission of "C" wiring.

48. SUB-GROUP "B" LINE FINDERS ONLY EQUIPPED

When only sub-group "B" line finders are equipped, "LL" wiring is omitted and "NN" wiring furnished, and the operation of relay (SB) when a call comes in with all "B" line finders busy and relay (CB) operated, operates the message register. Also relay (STA) is prevented from operating under this condition by the omission of "LL" wiring.

ENG.
E.L.F.
6-3-30
B.A.S.

CHK'D. E.L.F.

APP'D. A. PENROD
S.C.E.

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Western Electric Co., Incorporated,
Equipment Engineering Branch, Hawthorne.

(1 Pages, Page 1)
Issue 1 BT 52005-02
Appendix #3
February 26, 1926

This Appendix was prepared from ST-52005-02, Issue No. 24.

METHOD OF OPERATION

Trip Circuit - Start Circuit - Line Finder Circuit And District Selector Circuit - Arranged For Individual Message Register On Flat Rate Service - 400 Point Lockout Type Line Finder - Panel Machine Switching System.

Change paragraph 34 to read as follows:-

As the switch moves through position 7 1/2, the selector group register is under control of the (SL) relay and if the (SL) relay has released indicating that the subscriber has wiped out before the "selection beyond" position has been reached, the register will not operate, but if the (SL) relay is still operated the register will operate.

As the switch advances to position 7 3/4, *****etc.

ENG.--D.C.W.
February 26, 1926,
FP

CHK'D.--G.E.H.

APP'D.--E. R. COOKE,
H. G. J.

1. The first part of the report is a general statement of the work done during the year.

2. The second part is a detailed account of the work done in each of the various departments.

3. The third part is a summary of the results of the work done during the year.

4. The fourth part is a list of the names of the persons who have been employed during the year.

5. The fifth part is a list of the names of the persons who have been employed during the year.

6. The sixth part is a list of the names of the persons who have been employed during the year.

7. The seventh part is a list of the names of the persons who have been employed during the year.

Western Electric Co., Incorporated.
Equipment Engineering Branch, Hawthorne.

(1 Pages, Page 1)
Issue 1 BT 52005-02
Appendix No. 2
August 11, 1925.

This Appendix was prepared from ST-52005-02, Issue No. 18

METHOD OF OPERATION

Trip Circuit - Start Circuit - Line Finder Circuit and District Selector Circuit - Arranged For Individual Message Register or Flat Rate Service - 400 Point Lockout Type Line Finder - Panel Machine Switching System.

Change paragraph No. 42 to read:-

Should the line finder selector travel to tell-tale, due to the "N" and "C" segments being opened, the (LF) relay releases. The release of the (LF) relay, releases the "UP" magnet and also releases the (F) relay provided a sender has been found. The release of the (F) relay operates the (DS) relay which locks, operates the down drive magnet and reoperates the (F) relay, returning the line finder to normal.

ENG: P.E.B.
August 11, 1925.
EV

CHK'D. BY: G.E.H.

APP'D. BY: E.R. COOKE
H.G.J.

1. The first part of the report is a general statement of the purpose and scope of the study.

2. The second part of the report is a detailed description of the methods used in the study.

3. The third part of the report is a discussion of the results of the study and their implications.

4. The fourth part of the report is a conclusion and a list of references.

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Western Electric Co., Incorporated,
Equipment Engineering Branch, Hawthorne.

(1 Pages, Page 1)
Issue 1 BT 52005-02
Appendix No. 1.
July 28, 1924.

This Appendix was prepared from ST-52005-02, Issue No. 7.

METHOD OF OPERATION

Trip Circuit - Start Circuit - Line Finder Circuit and District Selector Circuit -
Arranged for Individual Message Register or Flat Rate Service - 400 Point
Lockout Type Line Finder - Panel Machine Switching System.

The reference to (F) relay in line 8 of paragraph 35 should read (H) relay.

ENG: B.S.
July 28, 1924.
F.G.H.

CHECKED BY: G.E.H.

APPROVED: E.R. COOKE
J.I.

This M. of O. was prepared from Issue 1 of ST-52005-02

METHOD OF OPERATION

Trip Circuit, Start Circuit Line Finder Circuit and District Selector Circuit - Arranged for Individual Message Register or Flat Rate Service - 400 Point Lock-out Type Line Finder - Panel Machine Switching System.

DEVELOPMENT

1. PURPOSE OF CIRCUIT

- 1.1 To establish connections between subscribers stations and the apparatus in the mechanical office.
- 1.2 To find the calling subscribers line and connect it with the various switching apparatus necessary to complete a call.
- 1.3 To provide a timing feature on signals to the attendant, when an originating call is not connected to a line finder in a specified time period.

2. WORKING LIMITS

- 2.1 This circuit has an external trunk supervisory loop of 5010 ohms at the outgoing end and at the incoming it has an external subscriber's line supervisory loop of 900 ohms maximum with a leak of 10,000 ohms.

OPERATION

3. PRINCIPAL FUNCTIONS

- 3.01 To start a line finder hunting for the calling line.
- 3.02 To trip the proper line finder brushes.
- 3.03 To operate the proper message register on a charge call.
- 3.04 To operate the line finder time alarm.
- 3.05 To disconnect the battery and ground from a subscriber's line on an incoming call.
- 3.06 To route the call.
- 3.07 To start a selector hunting for the calling line.
- 3.08 To release the trip relay in the associated trip circuit, thus permitting another call to start in any other group.

- 3.09 To prevent a second call being served in any trip circuit until all calls waiting in other trip circuits have been served.
- 3.1 Each regular start circuit is equipped with an emergency plug and jack for immediately replacing the regular circuit with an emergency circuit at any time.
- 3.2 To find the proper line and start the sender hunting for an idle sender selector.
- 3.3 To establish talking connection.
- 3.4 To supply talking battery to the calling station.
- 3.5 To select an idle sender.
- 3.6 To connect battery for the operation of the message register in the line circuit on a charged call.
- 3.7 To connect a busy tone to the calling station, if required.

CONNECTING CIRCUITS

- 4.1 Any standard line circuit.
 - 4.11 Start circuit arranged to prevent a second call in any group from starting until all calls waiting in other groups have been served.
 - 4.12 Any standard line finder and district circuit.
 - 4.13 Any standard final circuit.

DESCRIPTION OF OPERATION

5. ORIGINATING A CALL

The operation for a call originating in the first 20 lines of a group of 40 lines is as follows: When the receiver at the calling station is removed from the switchhook the (L) relay in the line circuit operates. The (L) relay operated connects battery to the H terminal of the line and operates the (BA) relay. The (BA) relay operated operates the (TR) relay from ground through the contacts of the (O), (BA) and (K) relays, secondary winding of the (TR) relay to battery in the start circuit over the TR lead and closes a circuit operating the (AL) relay in the start circuit. The (TR)

relay operated operates the trip magnets, opens the locking series circuit through the (TR) relays in the other trip circuits, serving other groups of 40 lines of the same 400-line unit and locks through its primary winding in series with the (STA) relay in the start circuit.

6. STARTING A LINE FINDER

When the (STA) relay in the start circuit operates, (a) It starts a line finder hunting for the calling line. Each trip magnet operates its trip rod, tripping the corresponding group brush of the line finder as it passes the tripping zone. (b) Short circuits the 500 ohm winding of the (CA) relay preventing it from operating while the (STA) relay remains operated. (c) Closes a circuit from ground operating the (K) relay under control of the (TR) relay. (d) Closes a circuit operating the (LF) relay in the line finder circuit, from ground through contacts of (GA) and (C) relays, (A-1) bridging brush and terminal of the (A) selector over lead ST, contact of the (MB) relay, contact of the test jack, to battery through 1000 ohm winding of (LF) relay. The (K) relay operated, locks to ground on the armature of the (BA) relay through the back contact of the (O) relay, opens the circuit through the secondary winding of the (TR) relay, thus preventing another line finder from being started by this call and operates the (LO) relay which closes the circuit through the 1500 ohm winding of the (O) relay and releases the (AL) relay in the start circuit providing the (AL) relay is not held operated over the (AL) lead of another trip circuit by a call waiting to be served. The (O) relay does not operate at this time on account of insufficient current through the winding.

7. The (LF) relay operated (a) locks on its contact and windings in series to ground on the make contact of the (H) relay. (b) Closes a circuit over lead Y operating the (GA) relay in the starting circuit. (c) operates the UP magnet from ground on the "N" commutator, brush and segment causing the line finder selector to travel upward and hunt for terminals on the calling line. (d) Closes a circuit from ground on the "N" commutator brush and segment through the break contact of the (E) relay, to battery through the inner winding of the (CI) relay, operating the (CI) relay.

8. The (GA) relay operated (a) removes ground from lead ST. (b) Locks to ground on the armature of the (STA) relay. (c) Closes a circuit operating the STP-A magnet.

9. SELECTING A SENDER

As the line finder selector starts upward, hunting for the calling line, a circuit is closed through the M commutator, slightly after the

brushes of the selector move off-normal. Ground on the M commutator brush and segment, operates the line finder (E) relay. The (E) relay operated, (a) Operates the (MB) relay from ground on its armature, through the break springs of the MB jack, to battery through the inner winding of the MB relay. (b) Closes a circuit from ground on the upper inner contact of cam I, make contact of the (E) relay, to battery through the inner winding of the (D) relay, operating the (D) relay, (c) opens the operating circuit of the (CI) relay, thus permitting the relay to release if the test brush of the sender selector is making contact with the test terminal of an idle sender. If the test brush of the sender selector is making contact with the test terminal of the busy sender, the (CI) relay locks through its outer winding, the lower contacts of cam S, make contact of the relay to ground on the test brush of the sender selector. With the (CI) relay held operated, the operation of the line finder (E) relay also closes a circuit operating the (F) relay in the line finder circuit and the district selector (SS) magnet. This circuit is traced from battery through the 1,000 ohm winding of the (F) relay and through the windings and break contact of the (SS) magnet, make contact, of the (CI) and (E) relays to ground on cam H, thereby stepping the sender selector brushes. If the next sender circuit is idle the (CI) relay releases, in turn stopping the selector, but if the next terminal is busy, the (CI) relay remains operated and the sender selector continues to step until an idle sender is found. When the (CI) relay releases, the test terminal of the selected sender is immediately made busy to all hunting sender selectors by ground connected to the test brush from cam H, through the make contact of the (E) relay and the break contact of the (CI) relay. This busy ground is connected until the switch advances from position 1 1/4. The operation of the (F) relay opens the tip and ring leads between the line finder commutator and the district circuit, and prevents the district (L) relay from operating and advancing the district switch from normal, if the line finder selector connects to the terminals of the calling line before the sender selector finds an idle sender.

10. MAKING THE DISTRICT BUSY - THE (MB) RELAY OPERATED

(a) Locks from ground on the armature and outer make contact of the (STA) relay in the START circuit, lead X, make contact, and outer winding of the (MB) relay, to battery on the break contact and armature of the (SL) relay, so that the (MB) relay will not release should be selector return to normal while another call is going through, (b) Closes a circuit from ground on the M commutator, make contact of the (LF) and (MB) relays, to battery through the 800 ohm winding of the (F) relay, which operates if the relay was not previously operated, (c) Connects ground on its armature to the series circuit through the (MB) relays of the other selectors in the same group, thus permitting the operation, over lead CH of the (CA) or (CB) relays in the starting circuit, when all line finder

selectors in the group are off-normal, (d) opens the circuit over lead Y, to prevent the (GA) relay from reoperating. (e) Transfers the ST lead to the next line finder, which, if busy, transfers the call over the ST lead in the same manner until an idle line finder is found.

11. As the line finder selector continues upward, at the end of the tripping zone, the "K" brush makes contact with the "K" commutator and connects ground to lead "K" which causes the (TR) relay in the trip circuit to release but holds the (STA) relay operated. The release of the (TR) relay closes the series locking circuit through the winding of the (TR) relays in the other groups and releases the two associated trip magnets. When the "K" commutator brush moves off the commutator segment, ground is disconnected from the "K" lead causing the (STA) relay to release. The release of the (STA) relay (a) opens the locking circuit through the (GA) relay which releases, (b) opens the circuit over lead "X" thereby opening the locking path of the line finder make busy relay, (c) opens the circuit through the STP-A magnet which releases and steps the brushes of the A group distributor selector to the next terminals, (d) removes the short circuit from the 500 ohm winding of the (CA) relay, but the (CA) relay will not operate unless all selectors in the group are busy.

12. LINE FINDER FINDS LINE

When the selector brushes make contact with the terminals associated with the calling line, battery on the "H" terminal operates the (O) relay in the trip circuit and the (H) relay in the line finder circuit. With the (H) relay operated, a 50 ohm non-inductive shunt is connected around its winding to ground on its armature for the purpose of increasing the amount of current through the 500 ohm winding of the (O) relay in the trip circuit thus speeding its operation. This is necessary on account of the very short time period during which the "H" brush makes contact with the "H" terminal before the circuit over the "H" lead is opened by the overthrow of the selector. The (O) relay operated opens the locking circuit of the (K) relay but the (K) relay is slow in releasing and holds the (LO) relay operated thereby holding the (O) relay operated through its 1500 ohm winding in order to permit the (BA) relay to release before the (O) relay. Otherwise another line finder might be started by this call. The (H) relay operated, opens the circuit which holds the (LF) relay operated, but the (LF) relay does not release immediately on account of a circuit being closed from ground on the "C" commutator brush and segment to battery through both windings of the (LF) relay in series. The (LF) relay is thus held operated until the brushes are centered on the terminals of the calling line. When the circuit through the "C" commutator segment is opened, the (LF) relay releases. The release of the (LF) relay (a) opens the circuit through the UP magnet, which stops the selector

brushes on the terminals of the calling line, (b) opens the circuit through the 800 ohm winding of the (F) relay so that when the circuit through its 1000 ohm winding is opened by the release of the (CI) relay when the district sender selector seizes an idle sender, the (F) relay will release, (c) closes a circuit operating the (SL) relay. This circuit is traced from ground on the "M" commutator, break contact of the (LF) relay, make contact of the (E) relay, winding of the (SL) relay, cam T, make contact of the (D) relay, to battery on the break contact of the (DS) relay.

The operation for a call originating in the last 20 lines of a group of 40 lines will be similar to that already described for the first 20 lines except that the (STB), (CB) and (GB) relays are involved instead of the (STA), (CA) and (GA) relays.

13. THE ADJUSTMENT OF THE "C" COMMUTATOR BRUSH

The adjustment of the "C" commutator brush, with relation to the tripped "H" multiple brush, is such that it does not break contact with the "C" commutator segment until slightly after the holding circuit through both windings of the (LF) relay is opened by the operation of the (H) relay when the H brush makes contact with the H terminals to which battery is connected. The UP magnet, therefore remains operated and the selector continues to travel upward until the brushes are carried slightly above the center of the line terminals, allowing the locking pawl to enter the notch on the rack attached to the brush support rod. At this time, the holding circuit through both windings of the (LF) relay is opened at the "C" commutator, releasing the relay. The (LF) relay released, releases the UP magnet. The selector then drops into place, thus centering the brushes on the line terminals.

14. LOCKOUT FEATURE

The operation of the lockout feature is as follows: The operation of the (BA) or (BAL) relay when a call is started operates the (AL) relay in the start circuit through the normally closed contacts of the (LO) relay. The (AL) relay operated, holds the (LO) relays of any other trip circuits locked up which may be operated. The operation of the (K) or (K-1) relay after the (STA) or (STB) relay operates causes the operation of the (LO) relay. The operation of the (LO) relay will release the (AL) relay in the start circuit provided it is not held operated over the (AL) lead of another trip circuit by a call waiting to be served. If no calls are waiting in other trip circuits the release of the (K) or (K-1) relay after the line has been found will release the (LO) relay. However, if calls are waiting to be served in other trip circuits the (AL) relay in the start circuit will remain operated, holding the (LO) relay in this

trip circuit operated. The (LO) relay operated holds ground on the 1500 ohm winding of the (O) relay preventing the (O) relay from releasing until calls waiting in other trip circuits have progressed far enough to operate their corresponding (LO) relays, thereby releasing the (AL) relay. The (O) relay being held operated prevents a second call from starting in this trip circuit.

15. OVERFLOW

If a line finder fails to stop on a subscriber's line on account of the H lead being open, due to the subscriber flashing his switchhook or for other reasons, the line finder will travel to the top of the bank where the brush will make contact with the H comb operating the (O) relay in the same manner as when the line is found. The T and R leads being open at overflow, disconnection takes place and the line finder returns to normal as soon as the sender is found.

16. EMERGENCY RELEASE OF START CIRCUIT

If either the (STA) or (STB) relay remains operated due to the failure of the (TR) or (TR-1) relay in the trip circuit to be shunted out and released, the (KF) relay operates as soon as interrupter contacts 1, 3 and 5 close and locks under control of the (STA) or (STB) relay. If it remains locked for approximately two seconds, interrupter contacts 2 and 4 close and connect ground to either the (TR) or (TR-1) relay in the trip circuit, depending on whether the call is through the A or B sub-group, releasing the (TR) or (TR-1) relay. When ground is removed by the opening of the interrupter contacts 2 or 4, the (STA) or (STB) relay releases releasing the (KF) relay and restoring the circuit to normal.

17. START CIRCUIT ALARM

The closure of the interrupter contact 6 which occurs at the same time contacts 2 and 4 are closed while the (KF) relay is operated, operates the (KA) relay. The (KA) relay operated locks under control of the key at the trouble desk, lights a lamp at the trouble desk individual to the line finder frame and operates an alarm. The operation of the key releases the (KA) relay, extinguishing the lamp and silencing the alarm.

18. ALL SELECTORS IN ONE SUB-GROUP BUSY

If all the selectors in sub-group A, for example, are busy, the (CA) relay operates in a circuit from ground over lead CH, 500 ohm winding of the (CA) relay to battery through the 600 ohm resistance C. The (CA) relay operated transfers the circuit over lead I from the winding of the (STA) relay to battery through the winding of the (SA) relay and the break

contact of the (SB) relay. When a call is now received the (SA) relay operates in turn operating the (STB) relay. The (STB) relay operated operates the (K) relay, starts a selector in the B sub-group hunting for the calling line, and closes a locking circuit through the 1000 ohm winding and make contact of the (CA) relay. This is to prevent the release of the (CA) relay should a selector become available in the A sub-group while a call is going through the B sub-group. If all selectors in sub-group B are busy, the operation is similar except that the (CB), (SB) and (STA) relays now operate. The (STA) relay operated, starts a selector in the A sub-group hunting as explained before.

19. ALL SELECTORS IN BOTH SUB-GROUPS BUSY

If all the selectors in both sub-groups are busy, both the (CA) and (CB) relays are operated. Should a call be received in either sub-group under these conditions the corresponding (SA) or (SB) relay operates but neither the (STB) nor (STA) relay operates as the circuits to ground on the armatures of the (CA) and (CB) relays are open. When a call is received in the A or B sub-group while all selectors are busy, the message register in the start circuit operates through the make contacts of the (SA) relay to ground on the armature of the (CB) relay if the call is in sub-group A or through the make contacts of (SB) relay to ground on the armature of the (CA) relay if the call is in sub-group B. The message register thus indicates the number of calls which were originated while all the line finders were busy.

20. LINE FINDER TIME ALARM

If a line finder does not find the subscriber's line within 35 seconds after the receiver at the calling station is removed from the switchhook, an alarm is given in the following manner: The (BA) relay operated connects battery to lead B, winding of the (frame) relay (B) brush and terminal 1 of the START arc of the time alarm selector, break contact of the frame relay (A) to the interrupter contact. When the interrupter contact closes, the (B) relay operates. The (A) relay does not operate, however, on account of its winding being short circuited by ground on the interrupter. When the interrupter contact opens, the short circuit is removed from the winding of the (A) relay, which now operates in series with the winding and made contact of the (B) relay, to ground on the armature of the (B) relay, thus holding both relays operated. The next operation of the interrupter operates the (TA) magnet, over a circuit from ground on the make contact of the interrupter, make contact of the (A) relay, terminal 1 and brush of the STEP arc of the selector, to battery through the winding of the (TA) magnet. When the interrupter contact opens, the (TA) magnet releases and steps its brushes one step on its back stroke. The selector

brushes advance one step for each make and break of the interrupter contact, which is of an interval of 7 seconds, until the fifth terminal of the selector is reached when the circuit through the interrupter is opened. When the fifth terminal of the selector is reached, the BA-1 lamp in the trip circuit lights from battery on the armature of the (A) (frame) relay, terminal 5 and brush of the LAMP arc of the selector, lead A, through the make contact of the (BA) relay, BA-1 lamp, lead C, to ground through the winding of the (B) (aisle) relay in the time alarm circuit, which operates. The (B) relay operated, operates the (A) (aisle) relay. The (A) relay operated, lights the aisle pilot and main or monitoring board lamps through their respective auxiliary alarm circuits. When the source of trouble is removed and the (BA) relay, in the trip circuit has released, the circuits over leads A and B are opened, in turn releasing both the frame and aisle (A) and (B) relays, extinguishing the aisle and main or monitoring board lamps and silencing the alarm. The release of the (B) (frame) relay also closes a circuit from ground on its armature, through terminal 5 and the bridging brush of the RETURN arc of the selector to battery through the break contact and winding of the (TA) magnet, which operates and steps the selector brushes to terminal 6, in which position it awaits the next closure of lead B.

21. RESTORING TO NORMAL

Should the circuit over lead B be opened before the fifth terminal is reached by the selector, the (A) and (B) frame relays release. The (B) relay released, causes the selector to advance to the next normal position, awaiting closure of lead B, as previously described. The operation of the (NL) key steps the selector burhses to the next normal position by way of the STEP bridging brush and 5, 10, 15, or 20 terminal, as the case may be. If the selector has been at normal position 6, 11, or 16, when the (BA) relay operated, the operation would have been the same as described for position 1.

22. SIMULTANEOUS CALLS

If there are simultaneous calls in both the first and the last 20 lines of a group of 40 lines the relays of both sub-groups will operate as described above, starting two line finders in different sub-groups at the same time. In this case the H leads of the two lines are connected together and connected to battery through the (O) relay. One of the line finders will stop on the first line. The other line finder will either stop on the second line or travel to overflow and return as described previously.

23. MESSAGE REGISTER

On message register calls on individual message rate lines the message register (MR) operates on battery over the H lead when the call is charged.

24. ADVANCING THE DISTRICT - RELEASING THE TRIP CIRCUIT

The (SL) relay operated, (a) connects battery to the "S" lead, making the line test busy at the final frames and operating the (CO) relay in the trip circuit (b) closes a circuit which operates the district (L) relay and (CH) relays. The (CO) relay operated, releases the (L) relay in the trip circuit which in turn releases the (BA) relay and opens the circuit through the primary winding of the (O) relay. Another call may now be started within this same group of 20 lines if the start circuit is ready for the call, provided there are no calls waiting in other groups which have not been served. The (CH) relay is operated by a circuit from ground on the N commutator brush and segment, through the break contact of the (F) relay, make contact of the (SL) relay, cam O, to battery through both windings of the (CH) relay. The same ground is then connected through cam R to battery through the 800 ohm winding of the district (L) relay. The (CH) relay operated, closes a circuit from ground on cam I, break contact of the (CS) relay, make contact of the (CH) relay to battery through the selector time alarm circuit not shown, which performs no useful function at this time. The (L) relay operated, closes a circuit advancing the district switch to position 2. This circuit is traced from battery through the R magnet, cam B, make contact of the (L) relay, to ground through cam M. As the switch advances from position 1, the circuits through the (L) and (CH) relays are opened, releasing the relays and disconnecting the selector time alarm circuit. In position 1-1/2 to 2, the associated sender is held busy by ground through cams H and C.

25. COMPLETING THE FUNDAMENTAL CIRCUIT

With the switch in position 2, the tip and ring leads are closed from the calling line to the tip and ring leads of the associated sender circuit, thus permitting the dialing tone to be transmitted back over the dialing circuit from the associated sender, as an indication that the apparatus is ready to receive the call by the operation of the station dial. The tip side of the dialing circuit is closed from the tip of the line, through the break contact of the (F) relay, cam P, to the tip brush of the sender selector. The ring side of the dialing circuit is closed from the ring lead of the line, through the break contact of the (F) relay, winding of the (DC) relay, cam Q to the R brush of the sender selector. In position 2, the (CI) relay operates through its outer winding to ground on cam S, and remains operated until the switch advances from position 10. The (CI) relay operated, (a) connects ground through the inner contacts of cam S, to the test brush of the sender selector, thus making the associated sender test busy after the switch advances from position 2, (b) closes the tip side of the fundamental circuit through to the sender and (c) closes the sender control (SC) through cams V and U, to battery through the outer winding of the (D) relay. After the sender functions, the fundamental circuit is established for the operation of the

district (L) relay and the stepping relay in the sender. This circuit is traced from ground in the sender circuit, through the FT brush, make contact of the (CI) relay, cam L, to battery through the 1200 ohm winding of the (L) relay, which operates. The (L) relay operated, locks through its 1200 ohm winding and make contact to the same ground over the FT lead and advances the switch to position 3 from ground on cam M. The 500 ohm winding of the (CH) relay is also connected through cam U, in parallel with the winding of the (D) relay to the SC lead. Should the (CH) relay operate at this time due to a high resistance ground in the sender circuit, no useful function will be performed.

26. DISTRICT BRUSH SELECTION

With the switch in position 3, the UP magnet is operated for brush selection over a circuit traced from battery through the winding of the magnet, cam C make contact of the (L) relay, to ground through the cam M. As the selector moves upward in position 3, carrying the commutator brushes over the commutator segments, the A segment and brush intermittently connects ground to the tip side of the fundamental circuit through cams K and L, holding the (L) relay operated, but successively short circuiting the stepping relay in the associated sender circuit, thus releasing and permitting its reoperation until the proper brush has been selected. When sufficient impulses have been sent back to satisfy the sender, the fundamental circuit is opened, releasing the (L) relay. The (L) relay released, opens the circuit through the UP magnet, thereby stopping the upward movement of the selector, and advances the switch to position 4. This circuit is traced from ground through cam M, break contact of the (L) relay, cam B, to battery through the R magnet. When two digit senders are used with this circuit, the advance of the sender replaces the high resistance of the SC lead with a 500 ohm ground, thus insuring the operation of the (CH) relay. In position 4, the trip magnet (TM) is operated from ground through cam S, and the (L) relay is operated and locked to ground on the fundamental circuit previously described, advancing the switch to position 5.

27. DISTRICT GROUP SELECTION

With the switch in position 5, the UP magnet is reoperated and, the trip magnet being operated, causes the previously selected set of brushes to trip when the selector starts upward. As the selector moves upward for group selection, carrying the brushes over the commutator segments, the B segment and brush intermittently connects ground to the tip side of the fundamental circuit through cam L holding the district (L) relay operated, but successively short circuiting the stepping relay in the associated sender circuit, thus releasing and permitting its operation

until the proper group has been selected. When sufficient impulses have been sent back to satisfy the sender, the fundamental circuit is opened, releasing the (L) relay which in turn opens the circuit through the UP magnet and advances the switch to position 6. When three digit senders are used with this circuit, the advance of the sender replaces the high resistance ground on the SC lead with a 500 ohm ground, thus insuring the operation of the (CH) relay. With the switch in position 6, a circuit is closed from ground on the line finder N commutator, brush and segment through the break contact of the (F) relay, make contact of the (SL) relay, inner contacts of cam O, cam R, to battery through the 800 ohm winding of the (L) relay, operating the relay. The (L) relay operated, advances the switch to position 7 in a circuit from battery through the R magnet, cam B, make contact of the (L) relay, cam M, make contacts of the (D) relay, to ground through cam I.

28. TRUNK HUNTING WITH TRUNK IDLE

Should the first trunk in the group in which the selector is hunting be idle, the (L) relay releases as the switch leaves position 6 1/4. When the switch enters position 6 1/2, ground is connected to the sleeve of the selected trunk through cam M, break contact of the (L) relay, cam E, as a busy condition until the switch advances to position 7 3/4.

29. TRUNK HUNTING WITH FIRST TRUNK BUSY

Should the first trunk in the group in which the selector is hunting be busy, the (L) relay is held operated in a circuit from battery through its inner winding and make contact, cam E to ground on the sleeve terminal of the busy trunk. With the switch in position 7, the UP magnet is reoperated from ground, cam M under control of the (L) relay and the selector travels upward until an idle trunk is found. When the idle trunk is found, the locking circuit through the inner winding of the (L) relay is opened but the relay does not release immediately, due to a circuit being closed from battery through its outer winding, cam R to ground through the C commutator brush and segment. When the brushes are centered on the trunk terminals, the circuit through the C commutator segment is opened and the (L) relay releases and opens the circuit through the UP magnet, which stops the selector brushes on the terminals of the selector trunk. The (L) relay released, also advances the switch to position 8.

30. "C" COMMUTATOR

The adjustment of the "C" commutator brush, with relation to the tripped sleeve multiple brush, is such, that it does not break contact

with the C commutator, until slightly after the holding circuit through the inner winding of the (L) relay is opened, by the sleeve brush leaving the busy terminals and making contact with the sleeve terminal of the idle trunk. The UP magnet, therefore, remains operated and the selector continues to travel upward until the brushes are carried slightly above the center of the trunk terminals, allowing the locking pawl to enter the notch on the rack attached to the brush support rod. At this time, the holding circuit through the outer winding of the (L) relay is opened, at the "C" commutator, releasing the relay which disconnects ground from the commutator feed bar, (G), releasing the UP magnet. The selector then drops into place, thus centering the brushes on the trunk terminal. During trunk hunting, in position 7 only, the commutator feed ground is supplied from ground on cam M under control of the (L) relay. This is to prevent the reoperation of the (L) relay by the closing of a circuit between the C commutator brush and segment on the overthrow of the selector or as it drops into place.

31. SELECTION BEYOND

As the switch advances to position 7 $\frac{3}{4}$, ground through cam E is connected to the sleeve of the selected trunk as a busy condition. With the switch in position 8, a circuit is closed from ground on the armature and make contact of the (CH) relay, through cam O, cam R to battery through the outer winding of the (L) relay which operates, advancing the switch to position 9. In position 9, the tip and ring sides of the outgoing fundamental circuit are closed through the tip and ring terminals of the selected trunk for selection beyond, through the FT and FR brushes of the sender selector, and cams F and G respectively. After the selection beyond has been completed, ground in the sender is removed from the SC lead, releasing the (CH) relay, in turn releasing the (L) relay. The (L) relay released, advances the switch to position 10. As the switch leaves position 9 $\frac{1}{2}$, the dialing circuit is opened at cams P and Q, in position 9 $\frac{3}{4}$, the tip and ring leads from the line finder are closed through cams P and Q respectively to 24 volts battery and ground in the district, holding the (DC) relay operated, under control of the station switchhook. With the (DC) relay operated, a locking circuit is closed for the (D) relay after the switch advances from position 10. This circuit is traced from battery through the inner winding of the (D) relay, make contact of the (DC) relay, make contact of the (D) relay to ground through cam I. The (D) relay (178-AK) is made slow in releasing in order that the connection will not be lost if the switchhook at the called station is momentarily depressed. With the switch in position 10, the sender circuit functions and connects ground to the FT lead, causing the (L) relay to operate and lock through its inner winding over the tip of the fundamental circuit previously described.

The (L) relay operated, advances the switch to the talking selection position until the relay is released by the operation of the sender circuit. As the switch advances, ground is intermittently connected to the tip side of the fundamental circuit, through cam E, holding the (L) relay operated, but successively short circuiting and permitting the reoperation of the stepping relay in the sender circuit. When sufficient impulses have been sent back to satisfy the sender, the fundamental circuit is opened, releasing the (L) relay. The (L) relay released, opens the circuit through the R magnet, stopping the switch in positions 11, 12 or 13, depending upon the class of call. As the switch leaves position 10, the holding circuit of the (CI) relay is transferred from ground on cam I to ground on cam E under the control of the (L) relay. This circuit is traced from battery through the outer winding of the (CI) relay, inner contacts of cam U, make contact of the (CI) relay, cam V, make contact of the (L) relay to ground through cam E. The release of the (L) relay opens the holding circuit through the (CI) relay, disconnecting the sender from the district circuit.

32. CALLED PARTY ANSWERS

When the received at the called station is removed from the switch-hook, with the switch in position 11 or 12, reversed battery and ground from the incoming circuit operates the (CS) relay. The (CS) relay operated, closes a circuit from ground on cam I, through cam N, winding of the (I) relay, to battery through the #3 contact of the 160-H interrupter. When the interrupted contact closes, the (I) relay operates and locks on the same ground through its make contact. When the #4 contact of the interrupter closes, the operation of the (I) relay closes a circuit from ground on the interrupter contact to battery through the 1000 ohm and 500 ohm windings of the (CH) relay in series, operating the relay. The (CH) relay operated, locks through its windings, cam O, to ground on its make contact and armature and closes a circuit from battery on its make contact for holding the (SL) relay operated. The 160-H interrupter is so connected in the circuit that the operation of the (CH) relay is delayed for at least two seconds after the (CS) relay operates. This delay is to prevent the false operation of the (CH) relay should the (CS) relay operate momentarily before the called party answers due to any line disturbances.

33. OPERATOR ANSWERS

The switch advances to position 13, as described above and when the operator inserts the plug of an answering cord in the answering jack of the trunk the (CS) relay operates on reverse battery and ground, over the trunk. The (CS) relay operated, closes a circuit from the same

ground on cam I, through cam R, to battery through the outer winding of the (L) relay, which operates and advances the switch to position 14. With the switch in position 14, the repeating coil and battery are disconnected and the T and R leads are connected directly to the T and R brushes of the selector through cams P and Q, respectively. As the switch enters position 13 1/2, the (L) relay locks in a circuit from ground over lead S of the selected trunk, through cam E, to battery through the make contact and inner winding of the (L) relay, and in position 13 3/4 the locking circuit through the inner winding of the (D) relay is transferred from the contacts of the (DC) relay to the contacts of cam J. In position 14, a checking tone circuit is closed over the sleeve of the operator's trunk, cam E, make contact of the (L) relay, cam V 2 M.F. condenser, cam W, the S brush and terminal at the line finder bank, to ground through the winding of the (CO) relay in the line circuit for number checking.

34. DISCONNECTION - REGULAR CALLS

When the receiver at the calling station is replaced on the switch-hook, the (DC) relay releases, in turn releasing the (D) relay. The (D) relay released, closes a circuit operating the (F) relay. The (F) relay operated, disconnects the tip and ring of the trunk from the line and closes a circuit from ground on the N commutator brush and segment, through its make contact, contact of cam D, to battery through the R magnet, advancing the switch to position 16.

35. MESSAGE REGISTERING

On message register district circuit, with the switch in position 16, a circuit is closed from battery, make contact of the (CH) relay, cam T, through the three 18-AN resistances in parallel, H brush and terminal at the line finder bank over lead H, to ground through the message register (MR) operating the message register. During the message registering period, another line finder selector hunting over the line terminals in the same group will not stop its brush on the multiple terminals of this line at this time on account of its (F) relay being shunted by the 5 ohm message register, while the H brush of the hunting selector is passing over the H terminal of the line. When the 149-C interrupter contacts close, a circuit is closed from ground, through cam R, to battery through the outer winding of the (L) relay, operating the (L) relay. The (L) relay operated, locks through its inner winding and make contact to ground on cam E. Ground on the II make contact of the interrupter is closed through cam X, make contact of the (L) relay, outer contacts of cam J, to battery through the inner winding of the (D) relay, which operates. The (D) relay operated, advances the switch to position 17 in a circuit from battery through the R magnet, cam B, make contact of the (L) relay, cam M, make contact of the (D) relay, to ground on cam I. In position 17 the A cam advances the switch to 18.

36. RESTORING LINE FINDER TO NORMAL

As the switch advances from position 16 to 18, the circuits through the (D), (SL), (CH) and (L) relays are opened, releasing the relays and disconnecting battery for operating the message register from lead H. The release of the (SL) relay disconnects battery from lead S, releasing the (CO) relay in the line circuit, thus restoring the line circuit to normal. As the switch enters position 17, the release of the (D) relay closes a circuit operating the (DS) relay. This circuit is traced from ground on the M commutator, brush and segment, through the 350 ohm winding of the (DS) relay, inner contacts of cam N, break contact of the (D) relay, to battery on the break contacts of the (DS) relay. The (DS) relay operated, (a) Locks through its make contact and 350 ohm winding to the same battery (b) Closes a circuit through the outer winding of the (P) relay, thus insuring the relay to hold until both the line finder selector and the district selector have returned to normal, and (c) operates the line finder DOWN magnet, from ground on its armature, restoring the line finder selector to normal. When the line finder selector returns to normal, ground is disconnected from the M commutator segment, releasing the (E), (DS) and (MB) relays.

37. RESTORING THE DISTRICT TO NORMAL

With the district switch in position 18, a circuit is closed from ground on the N commutator, brush and segment, make contact of the (F) relay, cam D to battery, through the district DOWN magnet, which operates and restores the district selector to normal. As the district selector returns to normal, a circuit is closed from ground on the Y commutator brush and segment, cam B to battery through the R magnet, advancing the switch to position 1 or normal. As the switch leaves position 18, the circuit through the DOWN magnet is opened and in position 18 1/4, the circuit through the outer winding of the (F) relay is opened, releasing the relay and restoring the circuit to normal.

38. DELAYED DISCONNECT

Should the calling subscriber fail to replace the receiver on the switchhook, after the called subscriber has disconnected, the release of the (CS) relay, due to the incoming trunk functioning, operates the selector time alarm circuit from ground through cam I, thereby notifying the switchman of the existing conditions.

39. DISCONNECTION TALKING TO OPERATOR

When the plug of the answering cord is in the trunk jack at the incoming end, ground is connected to the sleeve of the trunk to hold the district (L) relay operated. If the plug of the cord is removed from

the trunk jack before the receiver at the calling station is replaced on the switchhook, the line relay in the trunk circuit will operate, thereby holding the ground on the sleeve terminal of the trunk. When the receiver at the calling station is replaced on the switchhook, and the plug of the answering cord is removed from the trunk jack at the incoming end, the (DC) relay releases and ground is disconnected from the sleeve of the trunk, releasing the (L) relay, thus advancing the switch to position 15. As the switch advances from position 14 1/4, the locking circuit through the inner winding of the (D) relay is opened at cam J, releasing the relay. The (D) relay released, opens the circuit through the (SL) relay, which releases and operates the (F) relay, which advances the district switch to position 16 from ground on the N commutator brush and segment. In position 16, ground on the armature of the (SL) relay through cam D advances the switch to position 17, the A cam advancing it to position 18. In position 16, the (CH) relay being normal, battery is not connected over lead H to operate the message register in the line circuit as the call is not chargeable. From this point on, the line finder and district selectors are restored to normal as described in paragraphs 36 and 37.

40. DISCONNECTION ON ABANDONED CALLS

40.1 DISCONNECTION BEFORE LINE FINDER SELECTOR FINDS LINE

Should the calling subscriber replace the receiver on the switchhook before a hunting selector finds the line, the (L) relay in the line circuit releases, removing battery from the H terminals at the multiple bank, assuming the calling line to be in sub-group "A". The trip circuit and start circuits operate and in turn operate the (LF) relay which starts the selector hunting. The selector will therefore travel to the top of the bank and when the H brush of the selector makes contact with the terminal of the H comb, at the top of the multiple bank, the (H) relay operates. The (H) relay operated, releases the (LF) relay, which in turn releases the (F) relay and opens the circuit through the UP magnet, stopping the selector. The N commutator segment is opened with the selector brushes resting on the "H" comb terminal to prevent the district switch from advancing from normal when the (F) relay is released by the release of the (LF) relay. With the (F) relay released, the (DS) relay operates from ground on the X commutator brush and segment, through its 1,000 ohm winding. The (DS) relay operates the DOWN magnet, restoring the selector to normal.

40.2 POSITIONS 2 TO 6

If the receiver at the calling station is replaced on the switchhook while the district switch is in position 2 to 6, the dialing circuit is opened at the calling station, causing the sender circuit

to function and connect a direct ground, to the (SC) lead, causing the (D) relay to release on account of the increased current flowing through the outer winding of the relay. The (D) relay is connected differentially but does not release when its inner winding is connected directly to ground and its outer winding connected to ground in series with a resistance. The (D) relay released, operates the (DS) relay, which restores the line finder selector to normal as described in paragraph 36. The (D) relay released, also opens the circuit through the (SL) relay which releases. The (SL) relay released, disconnects battery from lead S, releasing the (CO) relay in the line circuit and advances the district switch to position 6 from ground on the armature and make contact, through the lower contact of cam D. With the district switch in position 6, a circuit is closed from same ground through cam D to battery through the DOWN magnet, operating the district DOWN magnet restoring the selector to normal. When the selector reaches normal, ground on the Y commutator brush and segment, advances the switch to normal.

40.3 POSITIONS 7 TO 10

Should the receiver be replaced on the switchhook while the district switch is in any of these positions, the line finder circuit is restored to normal as described in paragraph 36. Trunk hunting and selection beyond will take place in the same manner and the advance of the sender circuit advances the switch to position 10. In position 10, the release of the (D) relay operates the (F) relay which closes a circuit from ground on the N commutator brush and segment, advancing the switch to position 16. As the switch leaves position 15, the (SL) relay releases, The (SL) relay released advances the switch to position 17, the A cam advancing it to position 18. From this point on the district switch is restored to normal as described in paragraph 24.

41. TESTING LINE FINDER SELECTOR

- 41.1 The testing equipment which is shown associated with the start circuit provides for the testing of any particular line finder selector at any time. The test line used with the test box circuit for making the test is the first or bottom line of the bottom back in both the A and B sub-groups, the first line terminals in both sub-groups being connected together. When the #184 plug is inserted in the test jack of the line finder under test, the ST and ST-1 leads are connected together, and the circuit which supplied the battery to the ST lead through the (LF) relay in the line

finder circuit is transferred to lead Z, or if the automatic test circuit is used, the winding of the (LF) relay in the line finder circuit is connected through the test circuit to the start circuit over lead Z. When the plug of the test box cord is inserted in the test jack or the line finder is being tested by the automatic test circuit, the (A) relay operates from ground on the test jack or lead to automatic test circuit to battery on the contact of the (AL) relay, provided the (AL) relay is normal, indicating that there are no calls waiting to be served; and also in the case of the automatic test circuit, provided the line finder is idle. The (A) relay operating locks to battery on its contact, opens the circuit over the TR lead, thereby preventing any other calls from starting, opens the battery supply lead to the (AL) relay thereby preventing this relay from operating on calls waiting to be served, and connects ground to the winding of the (B) relay which operates if both (STA) and (STB) relays are normal, indicating that the start circuit is ready to handle the test call. The (B) relay operating locks under control of the (A) relay, closes the test line through, thereby operating the (L) relay in the test line, opens the series path for locking up (TR) relays in all trip circuits beyond the first, in series with the (STA) relay, thereby preventing a call from being started in a succeeding trip circuit after the start circuit is free and before the test circuit has had time to start the line finder under test, operates the (C) and (C-1) relays and connects battery to the winding of the (D) relay.

- 41.2 If the automatic test circuit has found the line finder busy the circuit through the (A) relay is left open, the (A) relay does not operate, and the test call is blocked until the line finder becomes idle. The (C) relay operated (a) opens the circuit through the (SA) relay preventing this relay from operating and starting a line finder in the B group in case all the line finders in the A group become busy while the test call is going through, (b) opens the normal ST lead, (c) connects lead Z through to the (STA) relay in the start circuit and (d) opens the circuit through the (STB) relay. The (C-1) relay operated (a) closes the circuit over the TR lead from battery on the normally closed contacts of the (STA) and (STB) relays, (b) connects the K lead of sub-group A with the K lead of sub-group B thereby connecting the K commutator segments of all the selectors of both sub-groups together and (c) connects the Y lead of sub-group A with the Y lead of sub-group B so that the (GA) relay will be operated by a selector in either sub-group. When the (L) relay in the test line operates, the trip circuit functions and connects ground through the (TR) relay in the trip circuit over lead TR,

make contact of (C-1) relay, break contacts of (STA) and (STB) relays to battery, operating the (TR) relay in the trip circuit. The above (TR) relay locks over lead I, break contacts of (CA) and (SB) relays to battery through the winding of the (STA) relay in parallel with the 1000 ohm resistance, operating the (STA) relay. The (STA) relay operated, short-circuits the 500 ohm winding of the (CA) relay, connects ground to lead K, operates the (D) relay, and closes a circuit from ground through the break contacts of the (GA) relay, make contacts of the (C) relay over lead Z to battery through the (LF) relay in the line finder circuit, causing the line finder to start hunting for the calling line. The (D) relay operated locks to ground on the armature of the (A) relay. When the (STA) relay releases after the line finder has passed the tripping zone, the (E) relay operates from ground on the left inner armature of the (STA) relay, make contact of the (D) relay to battery through the break contact and winding of the (E) relay. The (E) relay operated locks to ground on the armature of the (A) relay, releases the (C) and (C-1) relays, closes the series path for locking up the (TR) relays in the trip circuits beyond the first, which was opened by the (B) relay, closes the circuit from battery on the contacts of the (STA) and (STB) relays which was opened by the operation of the (A) relay and later closed by the operation of the (C-1) relay, through to the TR lead, and closes battery to the (AL) relay which was removed by the operation of the (A) relay. This leaves the start circuit prepared to handle regular calls.

When the plug of the test box cord is removed from the jack, or the automatic test circuit has been restored to normal, the (A) relay is released, releasing the (B), (D) and (E) relays and restoring the testing equipment to normal.

42. TELL TALE - LINE FINDER SELECTOR WITH BRUSHES NORMAL

Should the selector travel to the tell tale position while hunting, due to the multiple brush not being tripped, the (F) relay remains operated through its outer winding. Ground on the X commutator brush and segment is thereby connected to the lead "To tell tale circuit", giving a visual signal to the attendant. As the N commutator segment is open at the tell tale, the district is prevented from advancing from its normal position. The selector in this case is restored to normal, manually by the attendant.

43. TELL TALE - LINE FINDER SELECTOR - WITH BRUSHES TRIPPED

Should the selector travel to the tell tale position while hunting,

with the multiple brush tripped, the circuit is closed from battery in the trip circuit, terminal of the H comb at the top of the multiple bank, H multiple brush of the line finder selector, cam X, winding of the (H) relay to ground on the armature of the (DS) relay, operating the (H) relay. The (H) relay operated, releases the (LF) relay, which in turn releases the (F) relay and UP magnet. The (F) relay released, opens the circuit through the tell tale alarm and connects ground through the X commutator brush and segment, to battery through the 1,000 ohm winding of the (DS) relay, which operates, in turn operating the DOWN magnet restoring the selector to normal.

44. TELL TALE DISTRICT SELECTOR

Should the selector travel to the tell tale position during brush selection, it will stop in position 8 since the sender does not furnish the 500 ohm ground over the SC lead to operate the (CH) relay. If the district selector goes to tell tale during group selection, the district will stick in position 9, since the sender does not furnish the 500 ohm ground to operate the (CH) relay under this condition. In either position, the district will be held with its sender.

45. OVERFLOW

If all the trunks in the group are busy, the district selector while trunk hunting in position 7 will travel to the top of the group and rest on the overflow terminal. As the sleeve terminal at overflow is opened, the (L) relay releases, in turn advancing the switch to position 8. With the switch in position 8, the (L) relay operates from ground on the armature of the (CH) relay, advancing the switch to position 9. In position 9, a circuit is closed from ground on the Z commutator, brush and segment, through cam K to battery through the R magnet and advancing the switch to position 10. In position 10 a circuit is closed from ground on the Z commutator brush and segment through cam K, to battery through the 1200 ohm winding of the (L) relay, operating the (L) relay. The (L) relay operated, locks through its 1200 ohm winding and make contact to the same ground, through cam L, advancing the switch to position 14, from ground on cam M. As the switch advances from position 13, the (L) relay releases and in position 14 it advances the switch to position 15. The release of the (L) relay also releases the (CI) relay, disconnecting the sender from the district circuit. With the switch in position 15, the circuit is closed from the miscellaneous tone circuit over lead C to 2 M.F. condenser, cam G, winding of the repeating coil, 2 M.F. condenser, Cam V, cam J, make contact of the (D) relay to ground on cam I. A tone is therefore induced in the other winding of the repeating coil, thus causing an "all trunks busy" tone to be sent back to the calling subscriber. When the receiver at the calling station is replaced on the switchhook, the (DC) relay releases, opening the locking circuit through the (D) relay,

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which releases. From this point on, the switch is advanced to position 1 as described in paragraph 37.

46. "O" COMMUTATOR

The function of the "O" commutator segment is to maintain an idle condition on the multiple overflow terminal so that more than one selector may stop on overflow at one time; otherwise the first selector reaching overflow will make the sleeve multiple terminals busy, thus causing the succeeding selectors to continue upward into the next group of trunks. The O commutator segment is opened, at overflow but the S bar is continuous. Both the O and S commutator brushes are permanently strapped together and are wired to the multiple sleeve brush. When the selector is at overflow, the O commutator brush is resting on an open (dead) segment and as the busy ground is fed through the O commutator bar only, this arrangement maintains a non-busy condition on the sleeve terminals. When necessary to combine two or more groups of trunks, the multiple sleeve overflow terminals between the combined groups are made permanently busy by being connected to ground. As the S commutator bar is closed at overflow, the (L) relay is held operated, at this time, and the selector therefore hunts past the "make busy" terminals into the next group.

ENG. J.J.B.
August 27, 1924.
T.M.P.

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